

**Bull's Double Header Exercise:
Too Much Unsupported Roof**

Problem Booklet

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Instructions

This exercise tells about some miners who get into trouble. Read it one page at a time. (Don't jump ahead, but it's OK to look back.) On each page you will be asked to recognize problems, and good and bad ways to correct the problems. Some of the questions deal with how the problems came about, and how they can be prevented in the future.

Get together with two or three other individuals. As you read, discuss the questions and how they should be answered based on your own experience. Your problem booklet includes both questions and answers. Some answers are better than others. After each question, you will be asked to make choices about which answers are correct and which are incorrect. After writing your answers on the answer sheet, you are given feedback about how a group of "experts" answered the question. However, BEFORE looking ahead to see the expert's answers, it is very important that you record your answers to each question on your answer sheet.

The exercise is much more interesting and beneficial if you discuss each question with the others in your group and decide how to answer it before looking at the experts' answers. After marking your answer sheet, then look at the answers provided in the feedback section. Note any differences and discuss these with your classmates.

The events described in this exercise are based on real cases and on studies conducted by U.S. Bureau of Mines researchers.

Now, follow along as the instructor explains the background information and the problem. Then begin reading and answering the seven questions.

Bull's Double Header Exercise

Background

Section 004 has seven entries driven 1200 ft as the main route to a large reserve of coal which is to be mined. Geology and property lines permit only the seven entries for this section. The belt is in the #4 entry.

Coal is mined by one remote-controlled continuous miner, two shuttle cars, and a conveyor belt. The section also has one twin-boom roof bolting machine and one battery-powered utility scoop.

The coal seam is 60 inches. The pillars in this mine are 50' x 50' and the entries and crosscuts are 20' wide. The mine roof, a thinly bedded shale, is supported by 48 inch mechanical roof bolts, on 4 ft centers. A thick layer of sandstone lies about 2-3 feet above the roof throughout most of the mine. The mine floor is soft fire clay. If trammed too much or improperly, the continuous miner has a tendency to chew up the bottom.

This mine has approval to make extended cuts up to 34 ft from the last row of bolts. When making extended cuts, (1) the continuous mining machine must be controlled remotely from a permanently supported position outby the next to the last row of roof bolts, and (2) the miner operator shall not advance the cut to a point where a shuttle car canopy extends inby the next to the last row of roof bolts.

The roof control plan specifies that entries may not be advanced past an unbolted crosscut until at least 3 rows of roof bolts have been installed in the crosscut.

The ventilation plan calls for 6,000 cfm at the face. The continuous mining machine is equipped with a scrubber. Line brattices must be maintained to within the second from the last row of roof bolts outby the face.

A new cutting head has just been installed on the mining machine. The new head and bits are designed to cut coal rapidly and to generate less dust and vibration.

The roof bolting machine has been broken down for the last 2 hours. It is now

back in operation, but the bolters will have a hard time catching up with the miner.

Problem

Bull, the continuous miner operator, is excited about how fast the new miner head cuts. He advances the miner in the #4 belt entry, as shown in Figure 1. Soon, he has made a 40 ft extended cut. Then he backs the miner away from the face and starts the left-hand crosscut. He continues cutting until he has completed the left-hand crosscut as shown in Figure 2. Study Figures 1 and 2. Then turn the page, read Question A and write your answers on the answer sheet.

Figure 1. Bull makes a 40 foot extended cut.

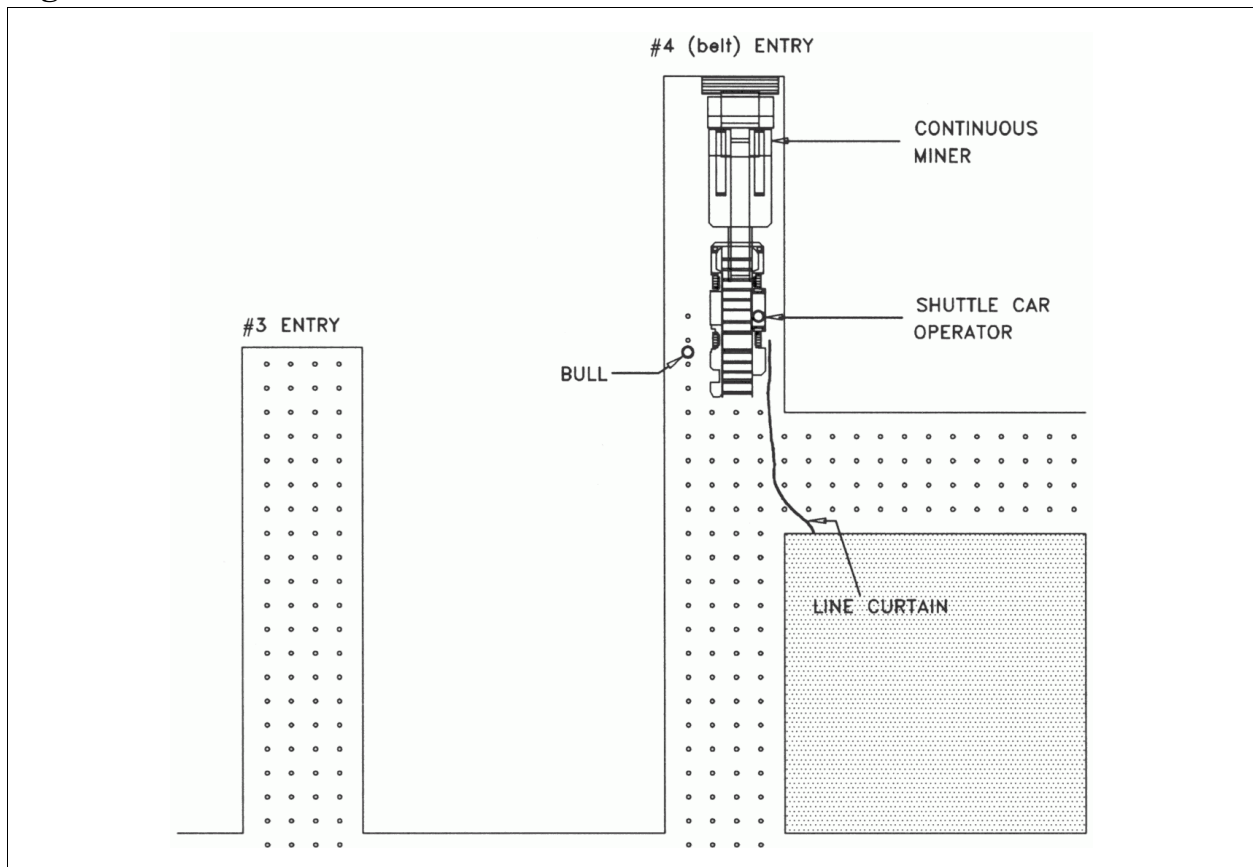
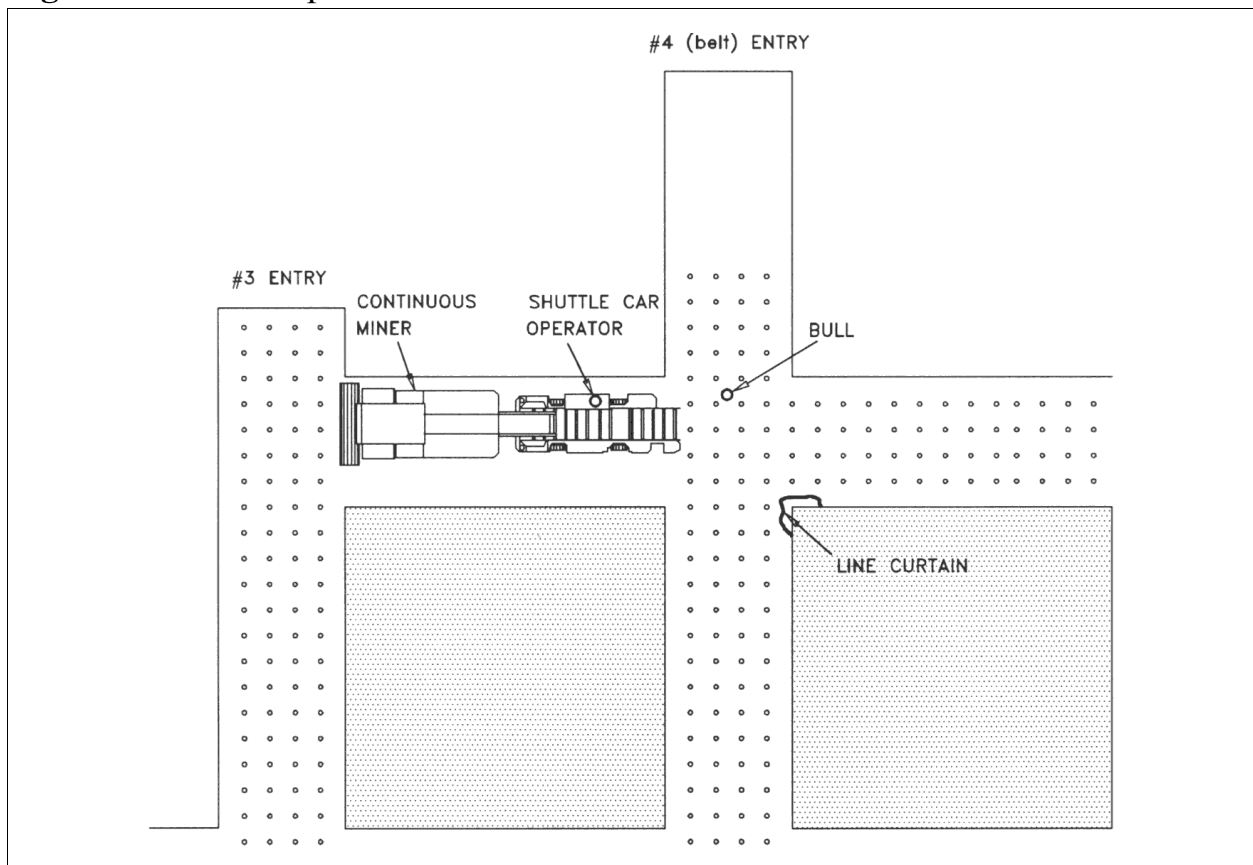


Figure 2. Bull completes the left hand crosscut.



Question A

The way that Bull is cutting coal may cause problems. Here are six statements about what Bull has done and why. After deciding whether you think each statement is true or false, mark your answers *on the answer sheet*. Place a **T** in the blank beside the statement number if you think the statement is true or an **F** if you think it is false. PLEASE DO NOT MARK ON THIS PROBLEM BOOKLET.

1. The roof control plan has been violated.
2. Bull has caused the shuttle car operators to tram their buggy canopies in by the last 2 rows of roof bolts.
3. The new cutting head cuts coal too fast.
4. If Bull continues with his tactics, there is a good chance that he will eventually cause down time and lost production.
5. One reason for Bull's punching through the left-hand crosscut before tramping the miner out of the entry may have been to prevent chewing up the mine bottom.
6. The way Bull is operating the miner is hard on the mine floor and may get the miner stuck.

Can you think of any other problems with the way Bull and the section crew are working? If so, make a note of it on your answer sheet so you won't forget to discuss it with the rest of the class later on in the exercise.

When you have finished discussing these statements with your group, and have marked your answers, turn the page and look at the feedback for Question A.

Question A Feedback

Now that you have read, discussed, and answered the 6 items in question A, review and discuss the feedback below. Compare the answers and notes to your answers and ideas. Based on your experience as a miner, feel free to debate and discuss these answers and notes.

- T 1. The roof control plan was violated because Bull made cuts in both the #4 entry and left-hand crosscut that exceed the limit set forth by the plan.
- T 2. By advancing the entry 40 feet from the last row of bolts, Bull has caused the shuttle car operators to advance their operator's compartment in by the last 2 rows of roof bolts.
- F 3. The fast new cutting head is not a problem. The problem is not following the mine roof control plan.
- T 4. Taking extended cuts that are deeper than permitted by the roof control plan may eventually result in a large roof fall. Cleaning up such a large fall could be difficult, dangerous, and time consuming.
- T 5. Bull's reason for cutting the left-hand crosscut before tramming the miner out of the entry may be related to his wanting to avoid unnecessary movement of the miner to prevent it from rutting the bottom so badly that the roof bolter or a shuttle car get stuck. However, taking cuts that are longer than the roof control plan allows (in two different directions) is likely to create more serious problems. What would you do in a situation like this? Why?
- F 6. The way Bull is operating the miner requires less tramming of the miner and is, therefore, easier on the mine floor. However, this shortcut to prevent the miner from getting stuck is dangerous and unwise and in violation of the mine roof control plan.

Turn the page and do Question B.

Question B

By the time Hank and Todd bring the roof bolting machine into the #4 entry to pin the top, Bull has finished making a crosscut through to the #3 entry and is now cutting in that entry. When they see the "double header", Hank and Todd get angry at Bull. (See Figure 3 on the next page.) They decide to go find the foreman and complain. The foreman comes back with Hank and Todd and they try to figure out the best way to bolt up the double header.

What should Hank and Todd do? (Using the answer sheet, place a **G** in the blank if you think the statement is a good choice or a **B** if you think it is a bad choice.)

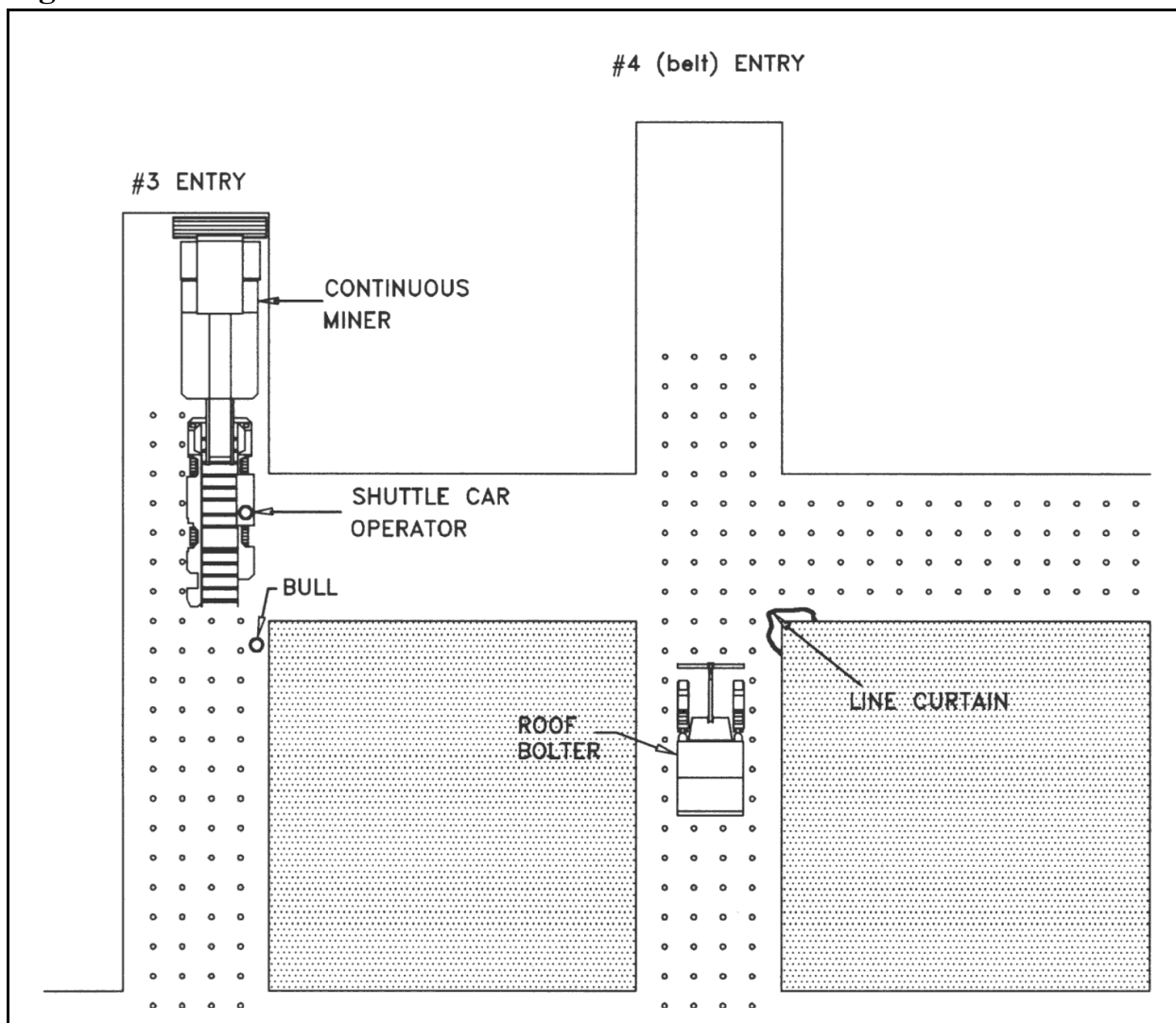
7. Before proceeding, and while staying outby the last two rows of roof bolts in the #4 entry, visually inspect the top and listen to the roof in both the crosscut and entry.
8. Ask the foreman to get with Bull and the shuttlecar operators right away and tell them to stick to the roof control plan.
9. Bring the roof bolter up the #4 entry, at the intersection turn left, and position the ATRS in the left crosscut--just beyond the bolts. While staying under the last row of roof bolts, sound the roof about one foot inby the last row of bolts in the left crosscut.
10. Check the 6 ft long test hole which should be drilled in the mine roof near the center of the intersection of the #4 entry and crosscut.
11. Bolt the #4 entry all the way to the face and then come back and bolt the crosscut.
12. Bolt the crosscut first, and then bolt the #4 entry to the face.

(Question B--Continued)

Can you think of any other good or bad choices that would be likely in situations like this? If so, make a note about it on your answer sheet.

When you have finished marking your answers, turn the page and look at the feedback for Question B.

Figure 3. Hank and Todd find Bull's double header.



Question B Feedback

- G 7. Gathering information by staying under supported top, and visually inspecting and listening to the top is a good idea. Suppose they heard the top working and saw a few thin pieces of shale fall off. How would this change how Hank and Todd should proceed?
- G 8. The foreman should immediately stop mining activity and confront Bull with his problem behavior. Otherwise Bull may continue to violate the roof control plan and expose crew members to serious roof fall hazards.
- G 9. Bull's double header has produced a much larger area of unsupported mine roof than is permitted. Therefore, while staying under the last row of roof bolts to protect himself from a fall, Hank or Todd should reach out about a foot and sound the mine roof. This test can help determine if it is safe for them to start bolting up the top.
- G 10. Because Bull's double header has made a much larger area of unsupported mine roof than is permitted, someone should check the test hole for signs that the roof may be unstable.
- B 11. This is a bad choice because the bolter operators would be in by an unsupported crosscut.
- G 12. This complies with the roof control plan. The bolter operators can get their job done while remaining under supported top at all times.

Turn the page and do Question C.

Question C

Hank and Todd are mad at Bull because he has made cuts that are too deep and is now advancing the miner in #3 entry past the unbolted crosscut. While the foreman goes to talk to Bull, Hank and Todd notice muddy water dripping at the intersection of the crosscut and #4 entry (which is unusual for this mine). They decide to check the test hole in the intersection, but find that the roof bolter operators on the previous shift did not drill one.

Now, what should they do? (Place a G or B in each blank to indicate whether you think it is a Good or Bad choice.)

13. Report the missing test hole and water dripping from the roof to the foreman.
14. Bolt the crosscut first, then drill the test hole in the intersection. Finally, bolt the #4 entry to the face.
15. Drill a test hole 6 feet deep near the center of the intersection.
16. Set a single line of temporary supports in the left-hand crosscut at the intersection; then bolt the entry to the face.

Can you think of any other good or bad choices that would be likely in situations like this? List them on your answer sheet now so you won't forget to discuss them with the rest of the class later on in the exercise.

When you have finished marking your answers and discussing them, turn the page and look at the feedback for Question C.

Question C Feedback

- G 13. These conditions suggest that a potentially hazardous situation exists. The foreman needs to know this immediately.
- B 14. The dripping water suggests that the roof may be unstable. A test hole should be drilled. No one should do any more work in this area until the test hole has been drilled and checked.
- G 15. This should reveal any separations or rider seams in the mine roof within or shortly above the height of the bolts.
- B 16. Setting a single line of jacks or timbers in the crosscut at the intersection and then bolting to the face is a bad idea. This exposes the bolter operators to a large area of unsupported roof on their left. Remember, the roof control plan calls for 3 rows of permanent supports before advancing inby the crosscut.

Turn the page and do Question D.

Question D

The foreman tells Hank and Todd to drill a test hole.

What things should they be sure to do? (Place a G or B in each blank to indicate whether you think it is a Good or Bad choice.)

17. Watch the drill steel carefully and listen to the way it sounds.
18. Empty the dust collection box before drilling the test hole.
19. After the hole is drilled run a metal tape rule up and down the hole.
20. Hank should lay his hand on the arm that raises the drill pot so he can feel how the steel advances in the roof.

Can you think of any other good or bad choices that would be likely in situations like this? List them on your answer sheet now so you won't forget to discuss them with the rest of the class later on in the exercise.

When you have finished marking your answers and discussing them, turn the page and look at the feedback for Question D.

Question D Feedback

- G 17. Visual and sound cues are important. When a drill steel jumps ahead, speeds up, or changes its sound (pitch), it may be due to a gap or soft place in the roof strata.
- G 18. Changes in the color of the strata, the presence of coal and dark colored laminations suggest a weak place in the roof. Dark shale contains carbon (coal) and tends to be weak. These conditions can be detected by examining the dust from the test hole.
- G 19. Separations and rider seams can be identified as the lip of the rule "hangs" on these cracks or lips. The numbers on the tape tell the depth of the separation.
- B 20. This is unsafe for at least two reasons: (1) His hand could be crushed by falling rock, and (2) his glove or sleeve could get tangled up in the rotating drill pot or steel.

Turn the page and do Question E.

Question E

Hank and Todd empty the dust box and start to drill a 6 ft test hole near the center of the intersection. After drilling about 4.5 ft, the drill steel begins to rotate faster and penetrate the roof more quickly. It only takes a few seconds for the steel to bore another 6 inches into the roof. Then, the drill steel returns to its prior (slower) speed of rotation and the rate of cutting becomes much slower. Hank and Todd realize that these changes in the rate of drilling suggest that a thin seam of rider coal may be present above the height of the bolts. The foreman looks in the dust box and sees a small amount of dark coal dust mixed in with the lighter dust that came from the test hole that they have just drilled. He then runs his metal measuring tape up into the test hole. As he slides the tape back down the hole it catches on a slight separation in the roof at 57" and again at 51". They all agree that they need to be using longer bolts, but there are none in this section. So, the foreman calls outside and asks for a load of 6 ft bolts to be brought to the section. About 30 minutes later the bolts arrive. Hank and Todd start to carry them to the roof bolting machine. As they near their machine a large roof fall occurs without warning. It extends from the outby edge of the intersection almost completely up to the face of the #4 entry and throughout most of the left-hand crosscut. The fall appears to be about 60 ft long, the full width of the entry, and about 5 ft to 6 ft thick in the center. (See Figure 4 on the next page.) Hank, Todd, and the foreman move outby and watch and listen. There is no roof noise and no more rock falls.

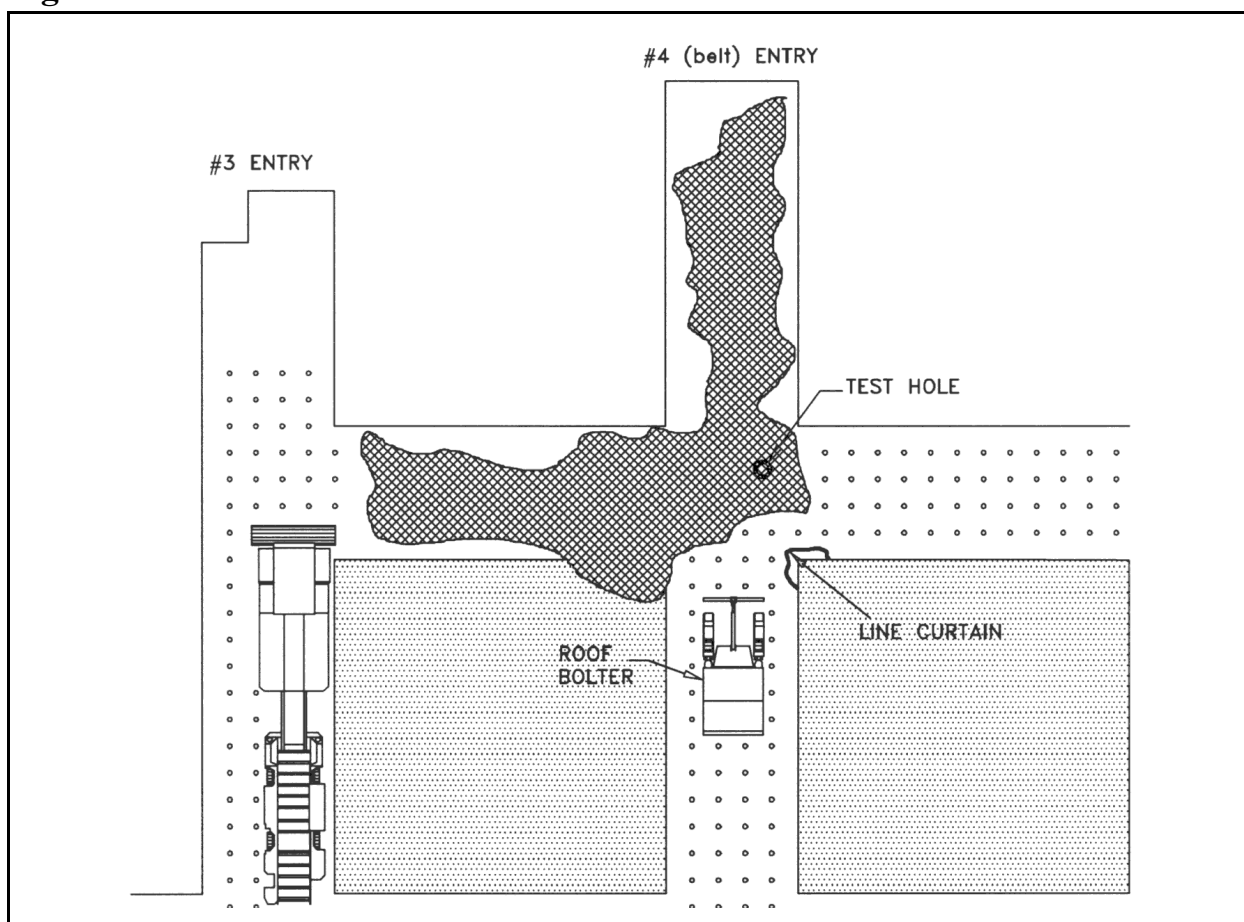
What should the foreman tell the face crew to do? (Place a G or B in each blank to indicate whether you think it is a Good or Bad choice.)

21. Construct two cribs under the last two rows of roof bolts in the #4 entry. Then abandon the section around the fall and use another entry.
22. Put four miners to work setting two rows of timbers, one row along each side of the entry, 4 ft out from each rib, and up to the outby edge of the fall. Then, staying between these timbers and the rib, inspect the fall and see how to best clean it up.

(Question E--Continued)

23. Have four miners set two rows of timbers, one along each side of the entry, 4 ft out from each rib, up to the outby edge of the fall. Then, bring the scoop in between the timbers and clean up the fall, setting timbers as the scoop advances.
24. Beginning from the intersection that is one crosscut (50 ft) outby the edge of the roof fall, drill a test hole and install additional roof support as necessary in the #4 entry. Then tell Bull to tram the miner into the #4 entry and use the remote control to advance the miner and begin to cut up and load the fallen rock.

Figure 4. A roof fall occurs.



(Question E--Continued)

Can you think of any other good or bad choices that would be likely in situations like this? List them on your answer sheet now so you won't forget to discuss them with the rest of the class later on in the exercise.

When you have finished marking your answers and discussing them, turn the page and look at the feedback for Question E.

Question E Feedback

- B 21. Abandoning this section of the #4 entry and going around the fall would be the best option except that this is the belt entry, and it has already been advanced 1,200 ft.
- G 22. Setting the timbers up to the edge of the fall would (1) allow miners to safely assess the "seriousness" of the fall and help in determining the best approach for cleanup, and (2) potentially keep the fall from riding back down #4 entry toward the feeder.
- B 23. Setting timbers along each side of the entry up to the outby edge of the fall, and using the scoop to clean up the fall, exposes the timber setters and scoop operator to hazardous conditions. There is a better way.
- G 24. Using the remote controlled miner to cut up and load the fallen rock is a good option because it prevents anyone from having to go under dangerous top.

Turn the page and do Question F.

Question F

The foreman decides to have the face crew install timbers and longer roof bolts at the 3 approaches to the fall, (from the right crosscut off # 3 entry, from the right crosscut off # 4 entry and in # 4 entry). Then, they clean up the fall by using the remote controlled miner to cut up and load the fallen rock into shuttle cars that have canopies to protect the operator compartment.

How should this process be completed? (Place a G or B in each blank to indicate whether you think it is a Good or Bad choice.)

25. Advance the continuous miner up to 34 ft past the last row of bolts to get most of the roof rock cut up, loaded into the shuttle cars and out of the entry. Then tram the miner out and bring the bolter in to bolt up the top.
26. Cut and load the rock into shuttle cars by advancing the miner about 10 ft at a time. After each 10 ft advance, back the miner out, bolt the roof up to the edge of the fallen roof rock, and repeat the process as necessary.

Can you think of any other good or bad choices that would be likely in situations like this? List them on your answer sheet now so you won't forget to discuss them with the rest of the class later on in the exercise.

When you have finished marking your answers and discussing them, turn the page and look at the feedback for Question F.

Question F Feedback

- B 25. Approvals to take extended cuts apply only to normal mining conditions when no unusual or hazardous conditions are present, and where roof control is in compliance. The approval to take extended cuts does not apply to THIS situation because (a) the miner has to be advanced into and past an unbolted crosscut, and (b) the roof may still be hazardous.
- G 26. Removing the fallen material and bolting the roof 10 ft at a time prevents a roof fall that could bury the mining machine, or a shuttle car. All this movement of equipment may be hard on the mine bottom, but this cannot be helped.

Turn the page and do Question G.

Question G

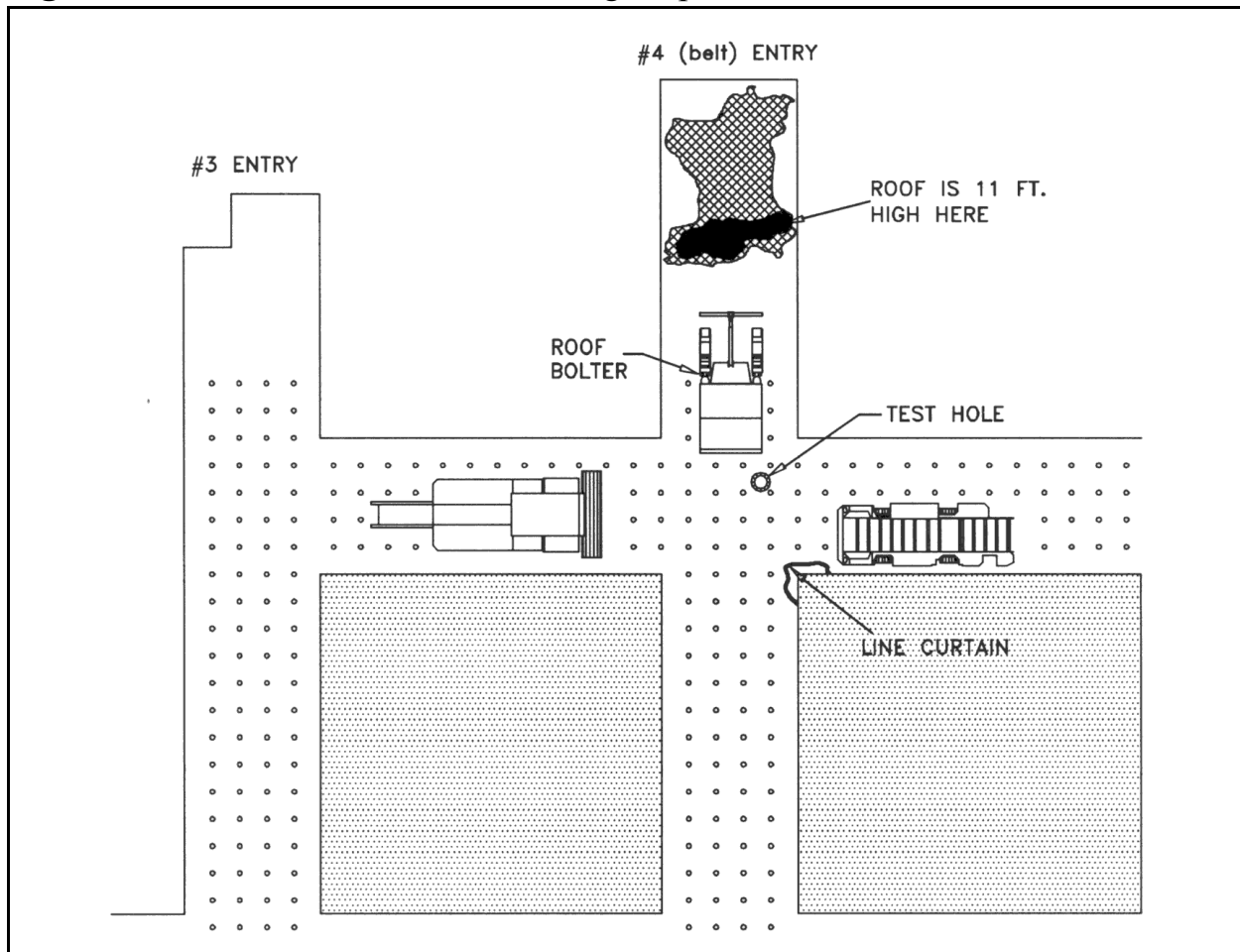
The section crew cleans up the roof fall in #4 entry by advancing the remote miner 10 ft, tramping the miner outby, bolting the 10 ft increment and repeating this process. Moving all this equipment cuts up the mine bottom and the shuttle cars and bolter get stuck and have to be pulled out. At one place Hank and Todd find that the fall has formed a cavity in the roof that is about 11 ft above the mine floor! The ATRS can only be raised to 8.5 ft. (See Figure 5 on the next page.)

How should Hank and Todd bolt the roof in this area? (Place a G or B in each blank to indicate whether you think it is a Good or Bad choice.)

27. Advance the roof bolter, raise the ATRS as high as possible even if it doesn't contact the roof, use an extension on the drill steel, and bolt up the top. Then advance the bolter and keep pinning the top in this same manner until the whole high-fall area has been bolted.
28. Set temporary roof support in front of the roof bolter machine. Next, use an extension on the drill steel to bolt up the high top while making sure the roof bolter operators stay within the temporary supports. Then reset the temporary supports, advance the bolter, and keep pinning the top in this same way until the whole high-fall area has been bolted.
29. Build a row of cribs up the center of the entry under the area of high roof. Then bring the bolter in and bolt the top around the cribs.

Can you think of any other good or bad choices that would be likely in situations like this? List them on your answer sheet now so you won't forget to discuss them with the rest of the class later on in the exercise.

When you have finished marking your answers and discussing them, turn to page 23 and look at the feedback for Question G.

Figure 5. The ATRS won't reach the high top.

Question G Feedback

- B 27. Using the roof bolter without having the ATRS firmly in contact with the mine roof is dangerous. Drilling and installing roof bolts in the unsupported roof further disturbs the roof and could cause a fall that could injure or kill the bolter operators.
- G 28. Timbers or special long screw jacks that can be raised from the bottom, should be set tight against the roof as temporary supports around the roof bolter. Only then should the bolter operator use the drill steel extensions to drill and bolt the roof. The temporary supports protect the bolter crew.
- B 29. Building a row of cribs up the middle of the entry under the high roof would be time consuming, expose miners to the hazards of roof falls for a long period of time, and the cribs would be in the way of the bolting machine.

It takes the rest of this shift and 4 more shifts to clean up and bolt the area!

Raise and discuss any other important points, issues or tactics that are relevant to situations like the ones described in this exercise.